EXCISION OF PORTIONS OF THE CHEST WALL FOR MALIGNANT TUMORS.[1]

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MALIGNANT growths of the chest wall as seen clinically are chiefly of two classes, carcinomata, secondary to primary tumors of the breast, or sarcomata (including endotheliomata) arising from the ribs, periosteum, skin, pleura, etc.

In these days of radical operation for cancer of the breast, which is apt to be performed earlier than formerly, the prognosis is far better than it was a few years ago; but still a considerable proportion of cases exhibit regional recurrences in spite of most radical work. These occur frequently in the chest wall itself and at various points along the path of the lymphatics leading from the mammary gland. Such recurrences may form anywhere along the inner side of the ribs or make a chain of nodules reaching to the spinal column, but are more common at the inner ends of the ribs or more accurately of the intercostal spaces where the branches of the internal mammary artery perforate the chest wall, presumably because of the passage here of numerous lymphatics on their way to the mediastinal glands. In two of the cases here reported the local recurrence was in a lymph gland situated in the intercostal space at its inner end.

In a number of instances the writer has seen such local recurrences after radical removal of tumors which had not yet become attached to the chest wall, but were still freely movable, and also in cases where the primary tumor was in distant portions of the breast. It would seem that lymphatic infection at the edge of the sternum is comparable in frequency to that of the axillary glands, which would suggest the systematic removal of all subcutaneous tissues in this region down to the

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perichondrium in all cases of carcinoma of the breast, whether the tumor be in the internal or external portions of the mammary gland.

In a certain proportion of cases these recurrences are local when discovered and may be successfully removed. The removal, however, requires resection of considerable areas of the chest wall, including all of its structures and entails opening of the pleural cavity on that side together with plastic closure of the defect.

It may be stated more broadly that regional recurrence after radical operation for carcinoma of the breast is very apt to involve the chest wall, and if such a nodule is to be successfully removed the underlying portions of the chest wall must be removed with it. This follows because in the modern radical operation for carcinoma of the breast practically all the subcutaneous tissues are removed from the whole breast area down to the periosteum and intercostal muscles, and any recurrent nodule growing beneath the skin may be considered to have invaded the intercostal muscles by the time it has become large enough to be detected. This is quite as true where the recurrence is the result of scattering of cancer cells in the connective tissue spaces as in purely lymphatic recurrence. Lenticular skin metastases in their beginnings are an exception to this rule.

Mr. Jacobson advises operation in such cases, which he says may be done with the expectation of at least delaying general infection with the disease. He reports one case, however, in which the patient was free from recurrence two years after resection of the chest wall.

Sarcoma of the chest wall may arise in any of the structures from the skin to the pleura, but the more common varieties grow from the ribs or their cartilages or the periosteum. The operative relations of sarcoma are not materially different, save for the fact that some of the varieties are encapsulated. Infiltrating sarcomata require the widest and most radical removal, while the encapsulated tumors and particularly the desmoids and the giant-celled sarcomata and often the

endotheliomata may be enucleated. Still even here the section should be made well outside the capsule since such capsules are themselves often infiltrated.

The following statement of the technique to be employed in such cases is based upon the experience obtained in the cases here reported:

A wide skin incision is made of such shape as to be readily closed by some simple plastic procedure. A curvilinear triangle answers admirably.

The chest is then opened through an intercostal space at some distance from the tumor sufficiently to permit of exploration of the inner surface of the ribs in the neighborhood of the tumor. By this means much can be learned of the extent of the growth and the presence or absence of involvement of the lung or pericardium. This will determine the area of chest wall to be removed. Of course it is of the greatest importance to take out the tumor in one piece without section of tumor tissue, but in some cases this may not be possible.

The ribs are first cut on the outer side, *i.e.*, the side of greater fixation preferably without cutting the pleura. By this means the intercostal arteries can be most readily caught by means of a curved needle carrying a catgut ligature. Further advantage lies in the fact that if the pleuroperiosteal section be made a little nearer the tumor than the bone section, the flap of periosteum and pleura will offer some protection to the lung from the sharp edges of the ribs.

In these cases there were no untoward symptoms incident to the production of pneumothorax. It was noticed, of course, that the respiration became immediately deeper and more rapid as soon as air entered the pleural cavity, but, aside from the violent flopping of the heart from right to left, terrifying to look at but without noticeable effect on the pulse, there was no special inconvenience to patient or operator. This is quite in accord with the statement of Dr. Park (ANNALS OF SURGERY, 1887) that one side of the chest may be operated upon without resort to artificial respiration, and with the work of other surgeons. A notable operation by Koenig, quoted by Park

(*Arch. f. klin. Chir.*, 1902, vol. xlvii, p. 314), might be mentioned. Trzebicky, in 1902, reported five extensive operations on the chest wall for the removal of tumors done without artificial respiration. This statement of Park may be worthy of reiteration here in view of the numerous apparatuses which have been devised to overcome the effects of the artificial pneumothorax. Doubtless Fell's apparatus and the Sauerbruch cabinet are of value in special cases, the latter essential in cases where there is likelihood of both sides of the chest being opened, but resection of the chest wall in the usual case can be done satisfactorily without these appliances. Dr. Keen reported a case in which he had removed a large sarcoma of the chest wall, and when the chest was opened he had tried to use Fell's apparatus without tracheotomy. The apparatus did not fit the face well and was discarded, and the operation completed without the occurrence of serious symptoms. The idea of Delagenierre that the chief danger in operative pneumothorax lies in the suddenness of its production (which led Dollinger to the establishment of an artificial pneumothorax under local anæsthesia twenty-four hours or so before performing an operation on the chest wall) is probably of considerable meaning and worthy of serious consideration. Probably, however, most of the advantages of Delagenierre's principle can be obtained during the anæsthesia by allowing the air to enter the pleural cavity only slowly, giving the system reasonable time to accommodate itself to the new condition.

In the cases here reported the writer found that the respiration could be greatly modified, and the tremendous lateral excursions of the heart and mediastinal tissues almost completely checked by the simple procedure of stopping up the opening in the chest wall with a wet towel. The towel, folded into two or three thicknesses, is made to slip beneath the partially loosened section of chest wall which is to be removed, and is drawn forward as new cuts are made. It is important to close the opening at the moment of complete expiration when the chest is largely emptied of air. When this was done the lung expanded and the exaggerated and fatiguing expiratory

efforts were at once quieted. When by gradual leakage considerable amount of air had accumulated in the cavity, the towel was readjusted and closure made again at the moment of complete expiration.

In those cases where the tumor was at the edge of the sternum, it was found convenient after cutting the ribs to raise the tumor to the inner side, bending the costal cartilages to permit of work beneath. The internal mammary artery was readily caught above and below by passing about it a curved needle armed with catgut and was tied before being cut. The section of the sternum was made with bone shears and included about half its width.

Removal of the tumor in several cases gave excellent exposure of the upper pericardium and of the mediastinum which in one or two cases showed enlarged glands which were readily removed with the surrounding fatty tissue.

The wounds were closed in each instance by a large skin flap lifted up from some convenient region, generally the upper abdomen where the laxity of the skin permits ready closure of the defect. In one case a flap was taken from the opposite side of the chest, the very full breast being held towards the median line with adhesive plaster: this with reference to Dr. Richardson's notion of using the opposite breast to assist in closing the large wound left by the radical operation for carcinoma of the breast. The amount of air left within the chest was made much less by letting it out during expiration and preventing its reëntrance by means of the closing flap, which to this end should be made somewhat larger than the opening in the chest wall. Absorption of the air was rapid so that in very few days the remaining pneumothorax was not demonstrable.

It was feared that the aspirating action of the lower pressure on the raw inner surface of the occluding skin flap would cause exudation in embarrassing amounts into the pleural cavity. This did not occur, however, unless in one case where a dulness was made out within a few days, but in this case there must have been some degree of infection, as the patient had a temperature of 100° to 103° F. for a week, and aspira-

tion failed to demonstrate fluid, probably a localized pneumonic process with pleurisy.

In all of the cases the respiration remained more rapid than normally for a week or more, for which I think the soreness incident to the movement of the ends of the ribs in the unhealed wound is quite as accountable as the remnant of pneumothorax.

The final condition of the wounds was satisfactory in all of the cases. Wide-spread but weblike adhesions were sufficient to prevent collapse of the lung during that operation in one case where a second operation was performed.

I would report five cases of resection of the chest wall for recurrent carcinoma of the breast in four patients and one of removal of the clavicle and first rib and portion of the sternum for sarcoma which in point of operative technique presented a number of similar conditions.

CASE I.—*Recurrent Carcinoma of Breast over Fifth Rib; Resection of Fourth and Fifth Ribs; no Evidence of Recurrence after Two Years.* Reported by courtesy of Dr. Stanley Stillman, of San Francisco.

Miss C. had been operated upon in 1899, at age of twenty-seven, by Dr. Lund, of Boston, for carcinoma of the right breast. In 1900 a recurrence in the scar was removed by Dr. Lund, in San Francisco, and in 1901 patient presented a hard, flat, immovable tumor about five centimetres in diameter situated over the fifth rib just outside the epiphysis. X-ray treatment was used three times a week for eighteen months. For a time the tumor grew smaller, then it began to increase in size, and radical removal was determined upon. Dr. Stillman removed some 5 centimetres of the fourth and fifth ribs with the adjoining intercostal tissues. Though the tumor projected through the chest wall, there were no adhesions to the lung and no mediastinal tumor was made out. The opening was closed by a skin flap lifted up from the abdominal wall. Recovery was rapid and uneventful. Patient was seen July 1, 1905, two years after operation, and showed no evidence of recurrence, but was in perfect health.

CASE II.—*Recurrent Carcinoma of Breast at Edge of Sternum; Resection of Fourth and Fifth Costal Cartilages with Edge*

of Sternum; Recurrence in Mediastinum after Eight Months; disappearing under X-ray, but reappearing Five Months Later.

Mrs. W., aged sixty-six years, had been operated upon by the Halsted method in January, 1902, for carcinoma in the outer upper quadrant of the right breast, which had been noticed for a year, and which had begun to invade the skin and had produced a large axillary tumor. In the operation everything had been removed from the edge of the latissimus dorsi to the sternum and from the first rib to the tenth. The skin wound was so wide as to require swinging flaps to effect closure. In November, 1903 (twenty-two months later), patient returned with recurrent tumor in the scar at the edge of the sternum over the fifth costal cartilage, $2 \times 3 \times 1\frac{1}{2}$ centimetres in diameter, sharply outlined, but fixed. There was no evidence of axillary or other recurrence, and the patient being in good physical condition it was determined to remove that portion of the chest wall carrying the tumor. A curvilinear triangular incision 7 centimetres on each leg was made and a skin flap lifted up from the upper abdominal wall sufficient to close this defect. The pleura was opened enough to admit the finger, which showed that the tumor was of about the same size on the inner surface of the ribs as on the outer, but did not involve the lung. An area of chest wall about 7 centimetres in diameter was removed as described above. During much of the dissection the pleural opening was closed more or less perfectly by the hand of an assistant or by a wet towel, by which the respirations were kept quiet and but little deeper or faster than the normal. The skin flap was stitched in place over the opening with silk-gut sutures and the edges accurately approximated with catgut. Before sealing the wound, a pair of forceps was introduced between the stitches and the greater part of the air let out of the chest, the forceps being quickly withdrawn at the end of expiration. Immediately after the operation the respirations were 22, but as patient regained consciousness they increased to 40, probably as a result of soreness. On the second day they were 28 and remained at 30 for several days. On the eighth day the wound was dressed for the first time; it had healed by primary union save for slight redness of the wound edges, and on the eleventh day the stitches were removed, patient leaving hospital on the nineteenth day. On the

sixteenth day a few drops of pus appeared in the abdominal portion of the incision.

In September, 1904, patient returned, showing two pea-sized recurrent nodules beneath the skin in the mediastinum. Further operation was deemed useless and patient was referred to the X-ray department of Lane Hospital for treatment. After 20 treatments by Dr. Lehmann during eight weeks, the nodules were no longer palpable, and patient returned home. In February, five months later, I was informed by letter that one of the nodules had begun to enlarge again, and that patient was very weak, probably from internal metastasis.*

CASE III.—*Recurrent Carcinoma of Breast at Edge of Sternum; Resection of Third and Fourth Costal Cartilages with Half of Breadth of Sternum; Recurrence in Original Scar apart from Field of Last Operation; Pleural Carcinoma; Death from General Carcinosis Five Months Later.*

Mrs. D., aged forty-five years, was operated on in February, 1903, by Halsted's method for a large spherical, rapidly growing carcinoma of the left breast with large axillary tumor; patient was very fat and had noticed the growth only five months before. In July careful examination failed to show any recurrence. In November several small nodules were discovered in the lower anterior part of the scar and were excised, the dissection going only to the periosteum. In March, 1904, two other recurrent nodules were found at the border of the sternum in the original skin, the flap of the last operation remaining free. As in Case II, the region about these nodules, 12 centimetres in diameter, was excised. One of the nodules was seen to penetrate into the fourth intercostal space. The patient being in good condition the pleura was opened through an intercostal space nearby and the inner surface of the wall examined with the finger. The tumor did not appear to have penetrated to the pleura, and the lung was free, but an enlarged gland was detected at the edge of the mediastinum.

The fourth and fifth costal cartilages were then cut away, the internal mammary artery tied and cut, and a section of the sternum 1½ x 5 centimetres removed. A second enlarged gland in the mediastinum was removed with the fatty tissue about it. Because of the retraction of the lung, a large area of the chest

* Reported to have died August 13 of cerebral hemorrhage.

wall was exposed to view, but no further recurrences were evident. After operation the pulse was 96 and respiration 30, but patient complained of very great pain. For the next week there was considerable fever, 99° to 103° F., pulse 90 to 110, with a good deal of pain, evidently a septic pleurisy or superficial pneumonic process. On the fourth day patient was more comfortable and sat up in bed. Some dulness was detected, presumably from effusion. On the eleventh day stitches were removed and a small abscess evacuated in the abdominal part of the incision. On the eighteenth day patient left hospital, respiration still 30, pulse 110. In May, two months later, patient returned with small recurrence external to last operation, and with wide dulness over left chest. Several punctures with needle brought no fluid, the dull area being probably caused by pleural carcinoma; further operation was out of the question. Patient died in July, four months after the resection of the chest wall and seventeen months after the Halsted operation, twenty-two months after patient first noticed the tumor.

CASE IV.—*Recurrent Carcinoma of Breast at Edge of Sternum; Inner Ends of First and Second Ribs and Portion of Sternum and Mediastinal Glands removed; Internal Mammary Artery tied at its Origin; Further Recurrence below; Resection of Third and Fourth Ribs; Patient well Six Months after Last Operation, Twenty-two Months after Halsted Operation.*

Mrs. M., aged fifty-three years, was operated on by Halsted's method in August, 1903, for a large suppurating carcinoma of the upper outer quadrant of the left breast with large axillary tumor. Patient was very fat, had noticed the tumor but four months before. This had been incised by the family physician for infection, suppuration continuing, and tumor grew out of the incision. After the operation much of the flaps used to close the incision about the drainage tubes sloughed and the resulting raw surface was so large as to require the application of Thiersch grafts, which was done as soon as the suppuration permitted. In August, a year later, patient returned with recurrence, 3 centimetres in diameter at the edge of the sternum, over the second intercostal cartilage. The tumor was widely circumscribed, the second rib cut across, opening the pleura 5 or 6 centimetres external to the border of the sternum and the internal mammary

secured by double ligatures in the second intercostal space and divided between. The first rib was then similarly cut and the sternum divided with bone forceps from below nearly in the middle line and as far as the level of the sternoclavicular joint. The mass was then turned upward to give access to the upper portion of the internal mammary artery, but it was not found practicable to secure the artery as high up as was desired, so it was caught in forceps in the first interspace and freed from the first rib. The tumor mass with first and second ribs, portion of sternum and sternoclavicular joint, was removed. It was then a simple matter to tie the internal mammary artery well above the position of the first rib and to remove the pleura and other tissues which had been in proximity to the tumor. The wound was closed with a large flap lifted up from the right side of the chest.

The patient was somewhat cyanotic during the early part of the operation (patient was very fat and had her chest cavity still further compressed by abdominal fat), but the pulse remained strong and regular. Through a considerable part of the operation the pleural cavity was well enough closed with a wet towel to permit of considerable expansion of the left lung, and when the towel was used the respiration was markedly quieter and approximated the normal.

After the operation the pulse was 82 to 100 and the respiration about 30. Primary union occurred and patient left hospital on the twentieth day. In the following November patient returned, but showed no evidence of recurrence. She was strong and well and able to do hard work. In January a small nodule was found at the edge of the sternum in the third intercostal space. A second resection of the chest wall was therefore done, since there was no sign of other recurrence, in which the third and fourth ribs and edge of sternum were removed. Gauzy but widespread adhesions of the lung to the parietal pleura prevented collapse of the lung so that the operation was much simpler than the previous one. It was interesting to note the demonstration of the portion of the heart which is uncovered by pleura, for this was beautifully shown when in expiration, the lung being confined by adhesions bellied forward all around this area.

On September 2, a third resection of the chest wall was done, this time for a recurrent nodule on the opposite side of the sternum. The inner ends of the second, third, and fourth ribs were

removed with the intervening soft parts as well as the sternum for its entire width and from the clavicular joint to the attachment of the fifth costal cartilage. Attached to the sternum and removed with it was a mediastinal tumor the size of a walnut. Considerable fatty tissue of the mediastinum was taken with the tumor, the dissection exposing the aorta. No serious symptoms resulted from the acute pneumothorax on the right side as the left lung in spite of the pleural adhesions and lessened mobility of the chest wall resulting from the previous operations gave sufficient breathing tissue. The wound was closed by a transplanted skin flap and the patient made a rapid recovery, leaving the hospital on the 18th day.

CASE V.—*Sarcoma of Clavicle involving First Rib and Sternum, with Large Mediastinal Tumor; Resection; Recovery, Patient being Well and Strong at the Present Time, Eleven Months after the Operation.*

W. H. H., aged seventy years, teamster, presented a large tumor at the base of the neck on the left side, fixed to and probably originating in the clavicle. Two years before he had injured the collar-bone, and three or four months afterwards noticed a small tumor near the inner end of the clavicle. The tumor continued to enlarge till it reached the size of about 10 x 15 x 8 centimetres, the long diameter being vertical. It covered the sternoclavicular joint and extended well up on the neck and over the upper chest. The skin contained many dilated veins, but was movable over the tumor, which was smooth in general outline, though coarsely lobed. Patient's general physical condition was excellent.

On August 16, 1904, under chloroform, the skin was incised, the edge stripped back, and the clavicle exposed and cut at the junction of its middle and outer third. The greater pectoral was cut across and the sternocleidomastoid divided about its middle. The clavicle was then tilted upward and the subclavius muscle divided. The first rib was then cut at a point internal to the subclavian vein without opening the pleura, the intercostal muscles cut, and the whole mass turned inward. A large lobe of the tumor the size of a hen's egg projected beneath the sternoclavicular joint into the mediastinum. In dissecting the subclavian vein from the tumor it was punctured near its point of union with the internal jugular. A little air entered, but compression with a gauze pledget sufficed to close the opening during the dissection.

In order to complete the separation of the vessels from the tumor the under side of the ligated external jugular was used as a guide and answered admirably. The internal mammary artery was not adherent to the tumor, but was lifted off it with the parietal pleura.

Because of the great depth to which the mediastinal lobe of the tumor extended, the uncertainty as to the quantity and character of adhesions of this lobe to the important structures of the mediastinum and the great difficulty of dissecting beneath so large a tumor, it was impracticable to complete the operation without dividing the tumor. Accordingly, the greater mass of the tumor was torn across and then section of the sternum was made with bone shears. The remainder of the tumor was then removed without difficulty.

While the pleura was not opened in this operation, the upper portion of the pleural sac was so widely freed from its parietal attachments that there was almost as much interference with the respiration as if the pleura had been opened and the bulging of the pleura into the wound with every expiration was annoying.

Whenever the pressure on the subclavian vein was released air would enter, and this occurred four or five times, but the quantity was small and it seemed to make no difference with the patient's breathing or pulse. The opening was finally closed with fine silk suture and fortified by a flap of fascia stitched over the suture line. The thoracic duct was not injured, as it probably would have been had not the external jugular been used as a guide and all the dissection carried on in front of it.

The wound was closed with drainage. Patient made a rapid recovery, being out of bed on the seventh day and leaving the hospital on the twelfth day.

At the present time (July 1), eleven months after operation, patient is continuing at his work as teamster, and his physician writes that he is well, having withstood an attack of grippe which tried his lung and shoulder in the coughing. There is no sign of recurrence as yet. Histologically, the tumor was an endothelioma.

In recapitulation, the writer would hazard the opinion that, although, to quote Watson Cheyne, "The patient's chance is in the first operation," there is still some chance for a certain proportion of cases with recurrence in sufficiently radical resection of the chest wall. Recurrences of the sort indicated are apt to be developed from remnants of the original tumor and

may in themselves be purely local. Radical dissection of the axilla is frequently followed by freedom of recurrence in that region because of the interruption of the process of metastasis by the lymph-glands. May not, in certain cases, the same thing be true of removal of infected lymph-glands of the chest wall and anterior mediastinum?

The artificial pneumothorax, if unilateral, presents no dangers sufficient to constitute contra-indication to the operation in patients well enough otherwise to warrant operation. The fatiguing respiratory efforts which supervene when the chest is opened may be almost entirely done away with by the use of a wet towel, covering the opening during the dissection.

As for results, it may be stated that of the six operations (including that of the sarcoma) there was no mortality, although most of the patients were well along in years, the ages at the time of the resections being 40, 46, 54, 68, and 70, with average of 55, and all except the sarcoma case having undergone radical Halsted operation, three cases within a year, the fourth within two years.

Of the four cases of recurrent carcinoma, one is dead four months after the operation (the tumor in this case was one of more than ordinary malignancy and rapidity of growth); one had further recurrence in the mediastinum after eight months, which disappeared under the X-ray but reappeared five months later, though patient is still living twenty months after the operation and twenty-eight months after the original Halsted operation; one had further recurrence in the next lower intercostal space for which a second resection was done in January last and is at present, six months later, free from recurrence, eleven months after the first resection and twenty-two months after the Halsted operation, and, finally, one is free from recurrence two years since the resection. (Case of Dr. Stillman.)

It is fair to state that in all of these cases but one, life has been prolonged, but it is still too soon, of course, to say whether any of the three cases which are to-day free from recurrence will remain so.